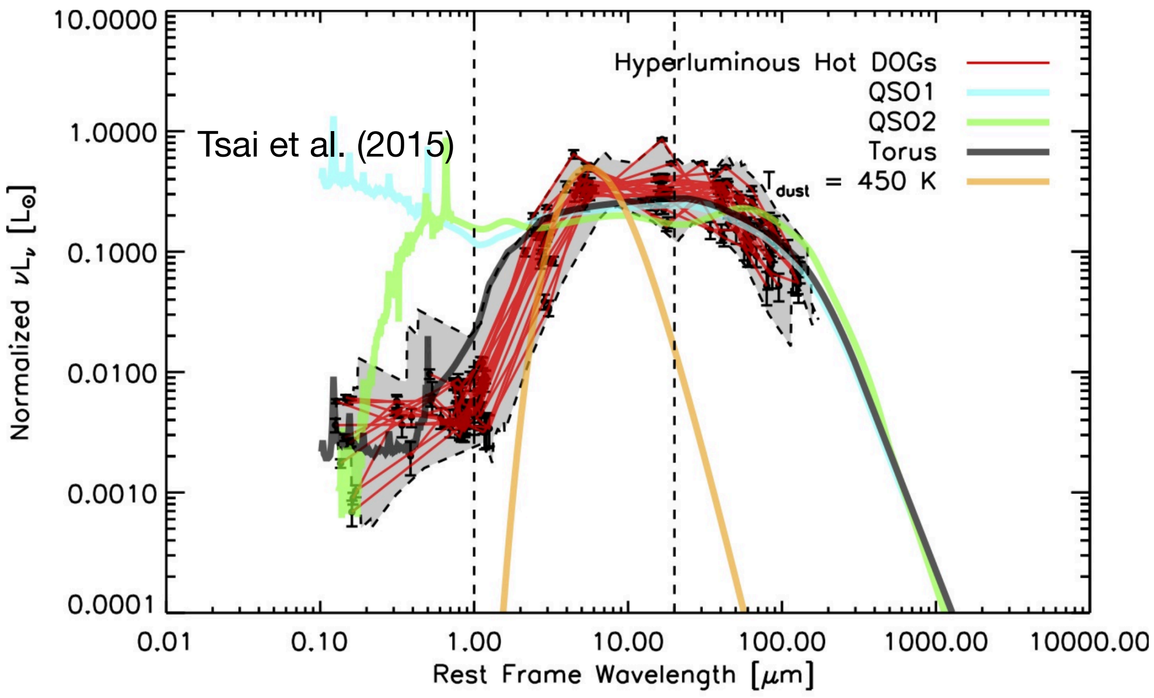
Heavy X-ray obscuration in the most-luminous galaxies discovered by *WISE*

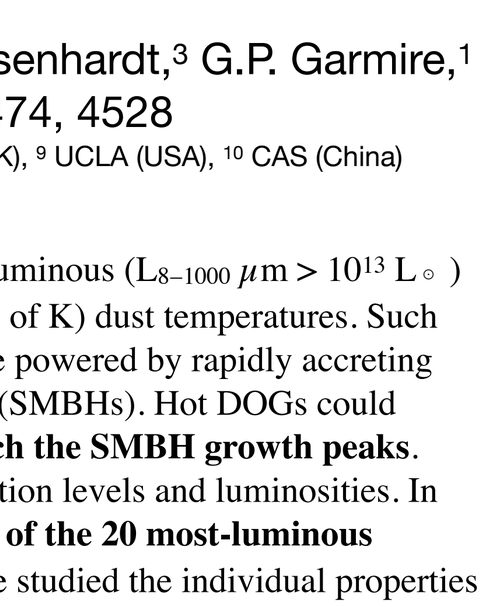
F. Vito,[1,2] W.N. Brandt,[1] D. Stern,[3] R.J. Assef,[4] C.-T. J. Chen,[1] M. Brightman,[5] A. Comastri,[6] P. Eisenhardt,[3] G.P. Garmire,[1] R. Hickox,[7] G. Lansbury,[8] C.-W. Tsai,[9] D.J. Walton,[8] J. W. Wu,[10] 2018, MNRAS, 474, 4528

[1] Penn State (USA), [2] PUC (Chile), [3] JPL (USA), [4] UDP (Chile), [5] Caltech (USA), [6] INAF-OAS (Italy), [7] Dartmouth College (USA), [8] Univ. of Cambridge (UK), [9] UCLA (USA), [10] CAS (China)



Hot Dust-Obscured Galaxies (**Hot DOGs**) are hyperluminous ($L_{8-1000\,\mu m} > 10^{13}\,L_\odot$) infrared galaxies with extremely high (up to hundreds of K) dust temperatures. Such extremely high luminosities and dust temperatures are powered by rapidly accreting and possibly deeply buried supermassive black holes (SMBHs). Hot DOGs could therefore represent a **key evolutionary phase in which the SMBH growth peaks**. X-ray observations can be used to study their obscuration levels and luminosities. In Vito et al. (2018), we presented the **X-ray properties of the 20 most-luminous known Hot DOGs ($L_{bol} \gtrsim 10^{14}\,L_\odot$)** at z = 2 – 4.6. We studied the individual properties of those covered by long exposure (10–70 ks) Chandra and XMM-Newton observations. One of these sources is a Compton-thick candidate, with column density NH = (1.0 – 1.5) × 10^{24} cm^{-2} derived from X-ray spectral fitting. Some Hot DOGs have been targeted by a Chandra snapshot (3.1 ks) survey and we applied a stacking analysis to investigate their average emission. We constrained the average obscuring column density and intrinsic luminosity to be $\log N_H > 23.5$ and $L_X \gtrsim 10^{44}$ erg/s. We

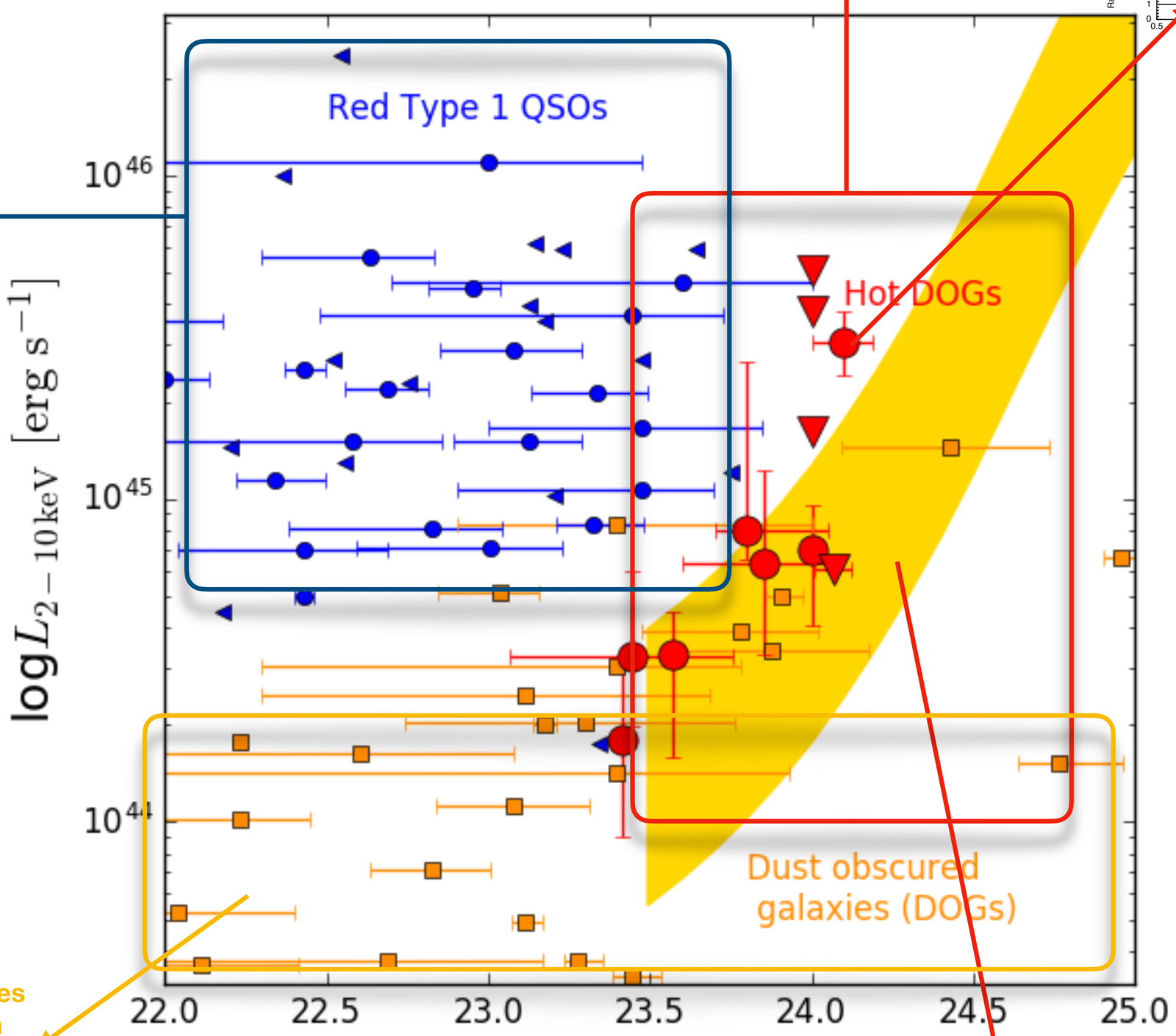
X-ray spectral analysis of individual sources reveal Hot DOGs host luminous ($L_X \gtrsim 10^{44}$ erg/s), deeply buried ($\log N_H \gtrsim 23.5$) AGN. They may thus represent the post-merger phase of maximally accreting SMBH, which is indeed expected to happen in obscured conditions.



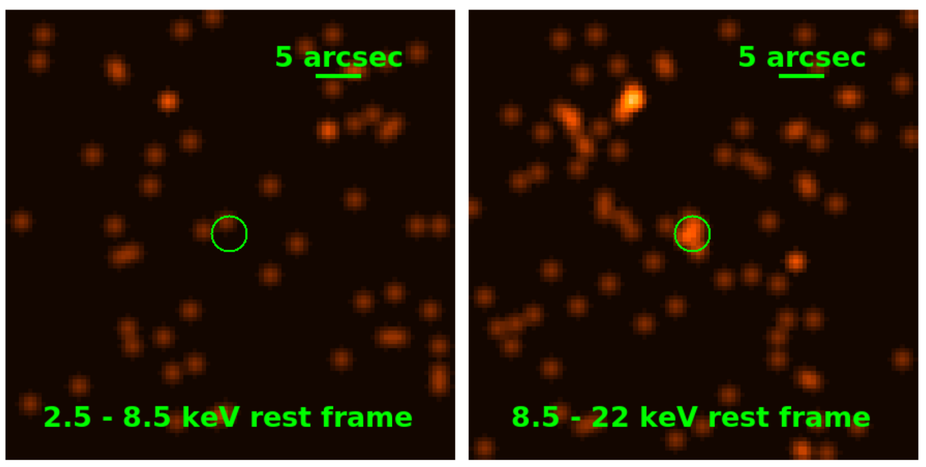
W0116-0505 (at z=3.173) shows indeed typical X-ray spectral features of a Compton thick AGN

During the so-called "blow-out" phase, massive outflows sweep away the obscuring material. The accreting QSO can then be directly seen as a Type 1 AGN. In this transitional phase, the QSO optical spectrum is reddened by the remaining surrounding dust.

Eventually, feedback allows the SMBHs to shine as a luminous blue QSO (out of the scale in the figure, due to the low absorption)



Dust Obscured Galaxies (DOGs) and Sub-mm Galaxies (SMGs), span a wide range of column density, and have lower X-ray luminosities than Hot DOGs, suggesting that they are accreting at a lower rate and/or their emission is dominated by star formation.



X-ray stacking analysis of undetected sources reveals that the average emission is very hard, confirming that the AGN powering these extremely luminous galaxies are heavily obscured (the orange stripe represents the 95% confidence region of the joint probability of the average L_X and N_H)